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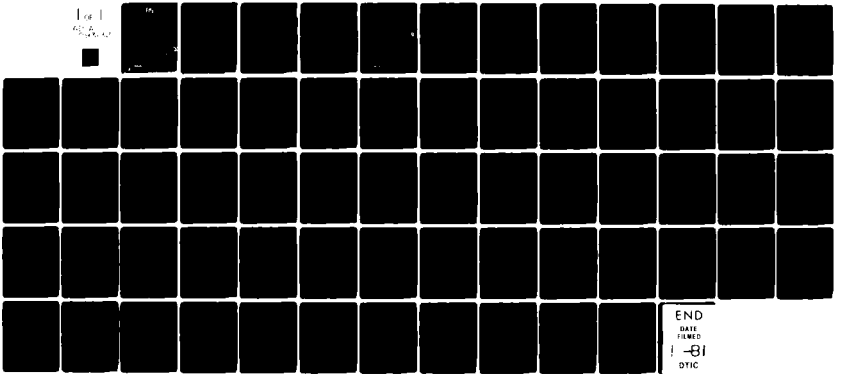

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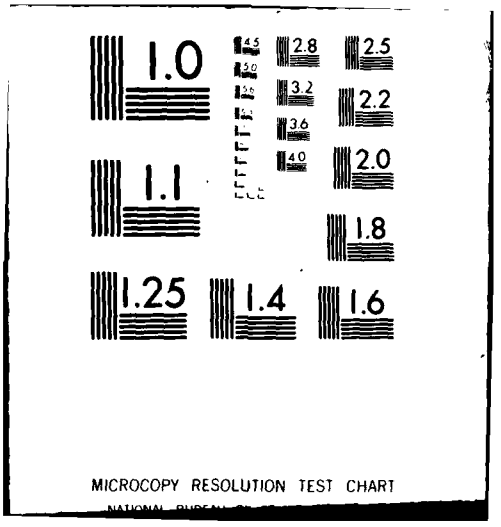
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A RAND NOTE

A MOBILE MISSILE BRIGADE FOR A POWER PROJECTION ROLE

R. A. Wise

June 1980

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Prepared For

The Defense Nuclear Agency

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N-1507-DNA A Mobile Missile Brigade for a Power Projection Role.# R. A. Wise. June 1980.

This report describes the synthesis of a Mobile Missile Brigade (MMB), designed to assist indigenous forces in the defense of Turkish Thrace against an armored invasion from the north. The focus of the organizational synthesis is on rationalizing the rate of fire incorporated in the brigade with respect to the target rate exhibited by a detailed model of enemy vehicular activity in the hostile rear. The organization of the MMB is developed around a notional surface-to-surface missile system capable of engaging vehicular targets with conventional munitions at ranges up to 200 km from the firing position. The combat power of the MMB consists of 54 launchers, grouped into 9 batteries of 6 launchers each. It is estimated, roughly, that the MMB would include about 2000 personnel. (Author)

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A RAND NOTE

A MOBILE MISSILE BRIGADE FOR A POWER PROJECTION ROLE

R. A. Wise

June 1980

N-1507-DNA

Prepared For

The Defense Nuclear Agency

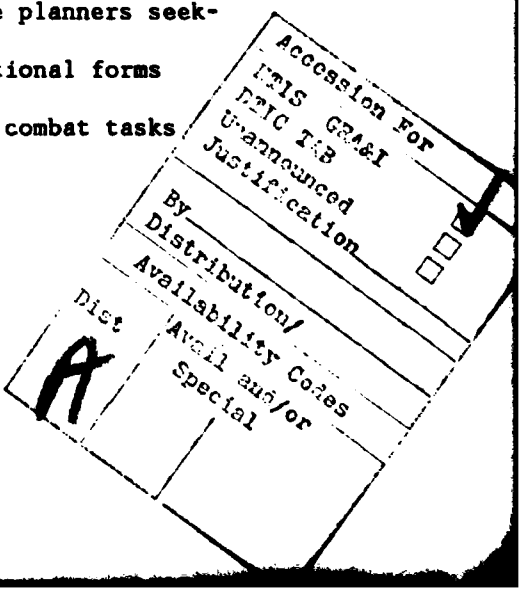
Rand
SANTA MONICA, CA. 90406

PREFACE

The synthesis of a hypothetical power projection unit, as described in this Note, was undertaken as part of a research project sponsored by the Defense Nuclear Agency entitled "Modern Forces for Power Projection and Counter-Projection." The purpose of the undertaking was to give organizational form to a particular set of ideas about the projection of military power in the decade ahead, and thereby to provide an exemplar that could assist researchers in studying many of the practical problems associated with this special segment of the nation's military needs.

This Note describes only a small part of the research performed under this project. The work discussed here supports a larger and more comprehensive inquiry into the nature of power projection forces; it should be viewed in this larger context. The Note should be of interest primarily to persons who have followed the main thrust of the research and who, in consequence, wish an elaboration of the rationale behind some of the force propositions advanced therein.

As an excursion in synthesizing a particular quantity and kind of combat power, the Note may also be of interest to service planners seeking innovative approaches to the development of organizational forms based on an explicit and rigorously defined statement of combat tasks and functions.



SUMMARY

New technologies promise to open the way to novel concepts and force designs for the projection of military power in the decade ahead. At the same time, U.S. requirements to project power to distant parts of the globe appear to be changing rapidly, as do the constraints imposed by a changing political and social order in the world. In short, it may be necessary for the United States to seek dramatically new means and forms of military intervention, built around new weapon systems that produce large amounts of combat power at little cost in manpower and support resources. This Note describes an excursion in force design, undertaken for the purpose of enlarging upon this proposition and exposing some of its implications.

The particular force element developed herein is a land force designed specifically to fulfill a rigorously defined role in a given scenario, namely, to bolster a Turkish defense of Thrace against an invasion by Soviet armor by defeating the second echelon and logistic support units before these elements can exert a decisive influence on the battle. The force is designed around a single notional weapon--a surface-to-surface missile capable of delivering a 500 lb warhead with high accuracy to a range of 200 km. The force is termed a Mobile Missile Brigade, or MMB.

The procedure followed in synthesizing the MMB represents a departure from the great body of conventional practice, in that it is not constrained by any regard for existing organizational forms. The synthesis begins by establishing, a priori, a number of organizational and

operational desiderata covering such fundamental design considerations as a modus operandi for the brigade, basic weapon system characteristics, strategic mobility, and measures for achieving the desired austerity in the composition of the force.

The overall combat power desired for the brigade is established through rigorous analysis of a postulated target model, which takes the form of a 5-day synthetic history of vehicular activity in the hostile rear. The focus of this process is on rationalizing the rate of fire incorporated in the MMB with respect to the target rate represented in the history.

Once this design point has been established, the synthesis turns to the issue of the internal organization of the combat power of the brigade. Subsidiary questions of employment concepts and engagement policies are explored and resolved. An inspection of the structure of the target model is brought to bear on the issue of battery size and internal arrangement.

The issues of surveillance, target acquisition, and internal logistic support are addressed, but only to the extent necessary to make reasoned judgments about their probable influence on the size and basic organization of the brigade.

The combat power of the resulting organization resides in 54 missile launchers, organized into 9 batteries of 6 launchers each. As a rough estimate, the manpower required in the brigade is about 2000 men. The ratio of personnel to missile launchers is 36:1, as compared to 47:1 in a U.S. Army Pershing battalion and 74:1 in an Army Lance battalion.

The MMB is designed to be transported entirely in C-141 aircraft.

The major support problem for the brigade was seen to be the supply of missiles to the firing units. It appears that at the peak of the MMB's involvement this resupply "requirement" could exceed 3000 tons in a 24-hour period. Support functions, including supply, maintenance, and medical service, were confined to two echelons--battery and brigade.

If the MMB were able to generate the amount of combat power suggested herein, servicing all of the targets appearing in the Thracian scenario would require the presence of two or perhaps three such brigades. The number would depend on the assumptions used about the length of the campaign and about the response of the Soviet force to attacks of the magnitude visualized in this particular synthesis.

The presentation here of a particular design for an MMB should not be interpreted as a position of advocacy; nor is it intended to depreciate the usefulness of other forms of combat power that perform other functions, arrive at other times, or use other weapons. Indeed, it would be patently unsound to rely on a single form of combat power and thus allow an opponent to devise counters with a high assurance of success.

CONTENTS

PREFACE iii

SUMMARY v

FIGURES xi

TABLES xiii

Section
I. INTRODUCTION 1

II. ORGANIZATIONAL AND OPERATIONAL CONCERNS AND DESIDERATA 5
The Role of the Mobile Missile Brigade 5
A Modus Operandi for the Brigade 7
A Weapon for the Brigade 7
Sustaining the Brigade in Combat 8
Strategic Mobility 10
Modularity in Organization 12
Air Defense 13

III. THE TARGET SYSTEM 14
Basis of the Target Model 14
Generation Rates for Targets and Events 18
Targets per Event 21
Duration of Events 22
Interpreting the Activity Levels 24
Extrapolating to the Thracian Scenario 26

IV. SYNTHESIZING A MOBILE MISSILE BRIGADE 28
Procedure 28
Firing Rate for a Single Launcher 29
Target Service Levels 31
Sizing the Brigade: How Many Launchers? 32
Tactical Groupings of Launchers 34
Organizational Levels Between Battery and Brigade 40
Logistical Implications of Target Rate 42

V. SUMMATION 45
The Tactical Structure 45
A Manpower Estimate 50
Topics for Further Related Research 52

FIGURES

1. Hourly Appearance of Targets 19

2. Distribution of Hourly Target Rate 20

3. Distribution of Hourly Event Rate 21

4. Distribution of Events According to Size 22

5. Distribution of Targets According to Transit Time 23

6. Target Service Rate as a Function of Number of Launchers in the Brigade 32

7. Tactical Structure of the MMB 46

TABLES

1. Outline of the Central Europe Scenario 16

2. Period-by-Period Appearance of Events and Targets 25

3. Practical Launch Rates, in Missiles per Launcher per Hour 30

4. Fraction of the Scenario Engageable by Batteries of Various Size 37

5. Options for Battery Size 38

6. Ratio of Personnel to Missile Launchers in Selected Organizations 52

I. INTRODUCTION

In a program of continuing research sponsored by the Defense Nuclear Agency, Rand has been exploring ways and means for improving the ability of the United States to project conventional military power to distant parts of the globe in the next decade. The research has focused particularly on the joint capabilities of precision-guided munitions and advanced surveillance and target acquisition systems, as means for generating combat power at minimum cost in manpower and support resources.

An earlier phase of this research produced a notional force--dubbed a Modular Self-Supporting Brigade, or MSSB--which was designed to engage large numbers of armored fighting vehicles, using both direct fire and indirect fire weapons systems of advanced design. Tactical maneuver, in the classical sense, was excluded from the mission and capabilities ascribed to the MSSB, on the assumption that the force would be used almost exclusively to reinforce the defensive fires of conventional units already in place.*

This hypothetical combat organization was examined at some length in two different war-fighting contexts. In the first of these, it was compared, somewhat cursorily, with a conventional U.S. mechanized brigade, as a force in mobile reserve during a large-scale war in NATO's Central Region. In the second scenario, the MSSB was embedded in a larger U.S. joint expeditionary force, deployed from the Continental United States (CONUS) to aid in the defense of Yugoslavia.

*James Digby and E. M. Cesar, Jr., Utilization of Modern Weapons Suitable for Europe (U), The Rand Corporation, R-2332-DNA, November 1978 (Secret).

The present research is concerned with yet a third scenario, one in which the object is to bolster the combat power of a nation on the periphery of NATO with whom the United States has a long-standing program of military aid and mutual defense. The setting is Turkey, and the threat is a Soviet attempt to seize control of Turkish Thrace, the Bosporus, and the Dardanelles.

The threat in this instance is not markedly different from that postulated in the earlier work mentioned above. On the other hand, the setting served to call attention to some important issues in power projection that were either absent from or greatly subdued in the other two scenarios. These issues will be treated extensively by E. Cesar and J. Digby of Rand, in other reports. They are introduced here only by way of providing a frame of reference for an exposition on detailed force design, which is the central theme of the present Note. These issues have to do with the mounting penalties and constraints associated with the establishment of a U.S. military presence on foreign soil in peacetime. They go, therefore, to the philosophical heart of the problem of designing U.S. power projection forces that represent truly viable capabilities for pursuing our interests in many areas of the world.

Despite the dramatic improvements in combat power that new technologies seem to offer, the fact remains that the deployment of any land-based force to a theater of war--either potential or active--carries with it inescapable and perhaps prohibitive costs. These costs stem from the need to provide logistic support, local security, and air defense; from the tenuous nature of base rights and status of forces agreements; and from the difficulty of coordinating operations with

local forces in the face of a language barrier of unknown dimensions. Such costs as these suggest that some of the time-honored approaches to power projection--notably the deployment of large numbers of conventional ground and air forces, and the prepositioning of substantial quantities of combat materiel--may have to be abandoned in favor of a more carefully circumscribed combat role and a drastic limitation on the numbers of personnel to be introduced.

But the problem of ancillary costs notwithstanding, the purpose of this Note is to synthesize a version of the MSSB that might nonetheless prove to be a viable alternative in the Turkish scenario. The aim is not to propose a particular organization as a model for power projection forces in this or any other scenario. Rather, it is to provide a test bed, together with a certain rationale for the size and structure of the force, to help other researchers focus their thinking about the land force alternative.

As a point of departure, Sec. II will address some of the operational and organizational concerns that make up the conceptual underpinnings of this particular notional force. These will lead in turn to statements of certain desiderata that should be incorporated in or otherwise reflected by the composition and organization of the power projection force.

One of the themes of the synthesizing effort is that both the size and the tactical structure of the force can and should be predicated on a studied view of the combat tasks it is expected to perform. In consequence, Sec. III of the Note describes a target model--actually a model of vehicular activity in the hostile rear area--in some detail, as a

basis for determining the combat strength and the tactical organization to be incorporated in the brigade.

The synthesizing process is described in Sec. IV. The resulting organization--termed here a Mobile Missile Brigade or MMB--is covered in the final section of the Note.

The presentation here of a particular design for an MMB should not be interpreted as a position of advocacy; nor is it intended to depreciate the usefulness of other forms of combat power that perform other functions, arrive at other times, or use other weapons. Indeed, it would be patently unsound to rely on a single form of combat power and thus allow an opponent to devise counters with a high assurance of success.

II. ORGANIZATIONAL AND OPERATIONAL CONCERNS AND DESIDERATA

When one undertakes to design a totally new combat element, a number of major issues must be settled before the actual work of defining an organization and assigning it a complement of personnel and equipment can begin. These issues include the role of the force, its modus operandi, the requirement for strategic--i.e., intertheater--mobility, the problems of sustaining the force in the theater, and so on. The discussion that follows addresses these issues in the context of the Thracian scenario. At the same time, many of the issues raised here, as well as some of the positions adopted by way of resolving them, seem to be relevant to other power projection scenarios.

THE ROLE OF THE MOBILE MISSILE BRIGADE

As suggested in the introductory section, there are some compelling reasons for wishing to keep the MMB as small as is possible, consistent with its intended mission of enabling the Turkish armed forces to stop the Soviet offensive before important objectives have fallen to the invader. Achieving this goal in any meaningful way requires that the combat role ascribed to the brigade must, from the beginning, be carefully circumscribed.

Historically, the configuration of power projection forces has tended toward infusing the target theater with quantities of conventional combat power in forms that closely resemble those already present. This approach is clearly at odds with the objectives of the present synthesis. The view adopted here is that it would be patently

unsound for the United States to augment Turkish forces with a relatively small increment of the kind of combat power the Turks already possess. In other words, the notion of a U.S. expeditionary brigade that simply takes its place in the line beside 20 or 30 Turkish brigades of similar size and composition will be rejected at the outset. The dictum is: Do not attempt to do anything for the Turks that they can reasonably be enabled to do for themselves.

This dictum suggests that the U.S. force should have no direct fire role and no role in tactical maneuver, since the Turkish Army has given convincing demonstration of its ability to master these functions. By the same token, there is little to be gained by reinforcing Turkish artillery with more of the same. What is left then is the application of combat power in the region beyond the range of conventional artillery, i.e., at ranges greater than, say, 15 km beyond the line of contact.

The scenario calls for a large Soviet force, consisting of as many as 10 divisions, to invade Turkish Thrace using more or less doctrinaire Soviet offensive tactics under conditions of conventional warfare. According to Soviet doctrine, these forces would likely deploy in a deeply echeloned fashion along the limited Thracian road net. From this it may be supposed that the important targets for the MMB will be the Soviet second echelon divisions, the combat support and logistic support units moving forward behind the first echelon, and the lines of communication (LOCs) over which they move. The design of the brigade will therefore aim at engaging these targets with a degree of success sufficient to prevent them from taking an effective part in the battle.

A MODUS OPERANDI FOR THE BRIGADE

Restricting the role of the MMB to that just described removes the need for detailed coordination between U.S. and Turkish forces, at the tactical level. The residual requirement for coordination lies mainly in the strategic and operational realms; in an agreement on general priorities for the application of combat power; and in arrangements that give the brigade the freedom to dispose itself, to displace, and to support itself without interference from Turkish forces or the Turkish populace.

Given a weapon system of sufficient range--say, 150 to 200 km--the MMB will be able to position itself at a depth that insulates it from the exigencies of the local battle. This means that the brigade can displace at will, and that it will need to displace only to avoid counterfire or to take new territory under fire. It also means that the MMB need not possess a high order of cross-country mobility.

This general mode of operation implies an expeditionary force that has its own surveillance and target acquisition systems, and that these systems be closely integrated with the weapon elements of the brigade.

A WEAPON FOR THE BRIGADE

Although no significant weapon design effort has been undertaken in the present work, it seems reasonable to postulate a surface-to-surface guided rocket with an all-up weight of 1500 to 2000 lb, carrying a 500 lb warhead, and having a range 150 to 200 km. Evolutionary extensions of weapons such as Lance, Assault Breaker, and Multiple Launch Rocket System (MLRS) are some of the likely possibilities for this role, as are

tactical versions of ground-launched cruise missiles (GLCMs).

Since the need for off-road mobility will be relatively modest, it should be possible to mount the missile launcher on a wheeled vehicle of comparatively simple design. Moreover, this vehicle can probably be adapted from an existing design, such as the launch vehicle for Honest John or the standard Army 5-ton wrecker.

The basic launch unit--i.e., the launcher vehicle together with whatever auxiliary transporters, loaders, and crew are needed--should have a design rate of fire of from 4 to 6 missiles per hour. (Some of the implications of rate of fire with respect to the size and tactical structure of the MMB will be discussed in Sec. IV.)

SUSTAINING THE BRIGADE IN COMBAT

Austerity is an unusually important attribute in the case of power projection forces that must be deployed rapidly over great distances. In designing logistic support for the brigade, it is important to keep in mind the inescapable truth that each soldier and each piece of equipment added to the force in the name of logistics must also be transported, supported, and protected. Therefore, one of the basic guidelines assumed for this synthesis is that the brigade should not be expected to endure in combat beyond two weeks or so without substantial additional U.S. intervention. This factor, combined with the restricted role ascribed to the brigade, makes the notion of austere logistical support substantially more plausible than would otherwise be the case.

The greatest single logistical burden to be contended with appears to lie with the supply of missiles. As will appear in a later section,

the "demand" for missiles in the Thracian scenario could approach a peak of 6000 missiles--i.e., 6000 tons--in a single day. Whether or not the expeditionary force and its external supply system should be configured to meet this demand will, for the moment, remain a moot point. But it is well to remember that the demand may have a certain legitimacy in the sense that the 6000th missile may have nearly as much combat utility as the 1st. More to the point, the order of magnitude of this demand heavily underscores the need to economize in other forms of support.

There are a number of avenues along which the needed economies may be sought. Among the obvious are these:

- The force should contain no tracked vehicles, to minimize the size of the maintenance component.
- No maintenance should be performed in the theater other than operator and one level of organizational maintenance.
- No reserve stocks should be established in the theater.
- Resupply should be delivered by air from points outside the theater to the point of consumption, with little or no transshipment.
- Abandonment and replacement of inoperable equipment should be favored over recovery and repair.
- Cannibalization of locally irreparable equipment should be the norm.
- Engineer support should be limited to that required to keep aerial ports in operating condition.
- Rations should be of the individually-packaged-meal variety.

- o Theater medical service should be predicated on a 24-hour evacuation policy. That is, the only treatment performed should be that which enables personnel to return to duty within 24 hours, and that which is needed to enhance survival of the sick and wounded during evacuation from the combat zone.

STRATEGIC MOBILITY

One of the chief criticisms leveled at current U.S. power projection forces is that they cannot be deployed in strength to distant parts of the world rapidly enough. The most widely endorsed measures for correcting this deficiency are a better capacity for deployment by air, and selective prepositioning of heavy materiel--either ashore or afloat.

Airlift

As visualized thus far, the MMB should be readily deployable in current strategic airlift aircraft--the C-5, C-141, and CRAF holdings. As new aircraft are designed for this role, it seems prudent and logical that they be configured to accept the equipment of the power projection forces that are seen to be in the offing. In any event, it would be surprising if they should prove to be less capable than current aircraft in any important way.

In R-2332-DNA, the argument is made that in many crises that call for the deployment of forces from CONUS, the C-5 fleet will be fully engaged in the reinforcement of NATO's center and thus not available for deploying forces to other parts of the globe during the early going. This prospect leaves the C-141 and CRAF fleets to provide strategic mobility

for the MMB. Of these two, the C-141 fleet seems to be the clearly preferred choice, since it is a military resource configured especially for military applications. In designing the MMB, therefore, compatibility with the capacity of the C-141 will be taken as a criterion for the selection of equipment.

In addition to the weight and size constraints on the brigades's equipment imposed by aircraft type, the deployment of the force will be governed by the number of aircraft available and the expected performance of the airlift fleet. It is estimated that the current C-141 fleet can deliver about 150 aircraft loads to Ankara from CONUS in the first 48 hours following a deployment order. Total deliveries should rise to about 300 loads by the 96th hour after the order is given.

Prepositioning

The prepositioning option has a number of disadvantages that argue strongly against it, at least in the context of future high technology power projection forces like the MMB. The major disadvantages are:

1. Prepositioned components must be replicated in a large number of locales about the globe if they are to be readily available during a crisis. The costs of providing and maintaining multiple sets of equipment against a variety of contingencies could easily overshadow any economies realized in the deployment function.
2. Prepositioning introduces an element of uncertainty about the availability of that which been prepositioned, in a time of crisis. In other words, the power projection force would, by design, become an uncertain instrument of policy.

These disadvantages are sufficient reason for ignoring the prepositioning option in configuring the MMB. If the brigade is deployable by air, the prepositioning option remains open, but a force configured on the assumption that some or all of its equipment will be prepositioned will not necessarily be deployable entirely by air.

MODULARITY IN ORGANIZATION

It has become almost an article of faith in force planning that a modular organization is good. Modular, in this sense, means that the force can be divided along organizational lines in such a way that each of its parts retains all of the essential qualitative characteristics of the force as a whole. This means, in turn, that a modular force offers considerable organizational flexibility in the ways it can be divided and allocated across a series of operational tasks or assignments. In the case of the MMB there are at least three reasons for taking the modular approach.

1. It suits the modus operandi discussed above.
2. It compensates in some measure for the difficulty of predicting force requirements accurately and precisely in crisis situations.
3. It offsets some of the uncertainty surrounding the way in which the brigade will actually arrive in the theater in a time of crisis.

AIR DEFENSE

Some provision must be made for protecting the power projection force from hostile air attack, but so far as the MMB itself is concerned the requirement should be minimal. The brigade will be a small force; its combat units will normally be dispersed; and its mode of operation allows for a liberal displacement policy. Therefore, no dedicated air defense unit need be incorporated in the MMB. The MMB should, however, be armed with secondary air defense weapons such as Stinger for local point defense.

On the other hand, the logistical system supporting the brigade--especially the aerial ports and LOCs--will almost certainly require substantial air defenses. But this is a problem that must be examined in the larger context of theater air defense, taking into account the contribution of Turkish surface-to-air missiles (SAMs) and antiaircraft artillery (AAA) units, Turkish air defense interceptors, and USAF air defense forces. No such evaluation will be undertaken here.

III. THE TARGET SYSTEM

In attempting to size the MMB and to decide upon its internal tactical structure, it is helpful to have at hand an explicit view of the target system the MMB is expected to engage. In the previous section the target system was defined as consisting of the second echelon forces and support units located beyond the range of conventional artillery, and the roads over which they must move. In this section the target system will be defined in considerably greater detail, with respect to the numbers of targets expected to be present, the rate at which they are expected to appear, their size, and the length of time they are expected to remain in view.

The targets in all cases are aggregations of moving vehicles.* The activity represented includes the displacement of second echelon combat forces, combat support and combat service support units, and air defense units. It also includes the movement of resupply and replacement vehicles going forward to replenish depleted units in the battle area.

BASIS OF THE TARGET MODEL

The basis for this particular target model was provided by earlier research at Rand, which evaluated the potential vulnerabilities of the Soviet tactical rear during large-scale armor operations in Central

*Since the roads are fixed targets that can be attacked in a somewhat more leisurely fashion than can the vehicular traffic, they have little or no bearing on sizing the combat power of the brigade. Consequently, they will not be carried forward in the synthesis. This is not to say, however, that the brigade should not have the ability to attack bridges and defiles with its missile launchers.

Europe.* This work produced, among other things, a synthetic history of all of the vehicular activity presumed to take place along the breakthrough axis of a Soviet tank army in the first echelon, during a 5-day scenario. The history records the time and place each movement event begins, its destination and time of arrival, and the numbers and types of vehicles involved in the event. The scenario is described in Table 1.

While there are notable differences between the way an offensive campaign might proceed in Central Europe and the way it might evolve in the Thracian scenario, the Central Europe model has enough tactical variety to be of use in evaluating the Thracian case. The logic and the movement algorithms that underlay the construction of the original history were tied directly to the presumed character of the battle at the point of engagement. As this character changed, particularly with respect to rate of advance, attrition rates, and expenditure of ammunition and other supplies, the activity in the rear area also changed. It is possible, therefore, to view the history selectively and to focus on those parts of the scenario that conform best to one's presumptions about the progress of a Soviet offensive in Turkey.

In the following discussion, particular meanings will be attached to several common terms.

- EVENT. An event is the movement of a group of vehicles that have the same origin, starting time, speed, route, and

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D. E. Lewis et al., Potential Vulnerabilities of the Warsaw Pact Tactical Rear: Methodology and Input Data (U), The Rand Corporation, R-2232-AF, October 1978 (Secret); R. A. Wise et al., A Model of Vehicular Activity in the Warsaw Pact Tactical Rear During a Conventional Attack Against NATO, The Rand Corporation, N-1495-AF (forthcoming).

Table 1

OUTLINE OF THE CENTRAL EUROPE SCENARIO

Period Number	Time Span	Principal Activity
1	0600 - 1800 D-day	Leading regiments cross the border and attack the defender's covering force, driving it in by the end of the period. Distance advanced: 25 km
2	1800 D-day to 0600 D+1	The first echelon division probes the defender's Main Battle Area (MBA) and prepares to launch a coordinated breakthrough attack. The second echelon division moves forward and occupies the assembly area that was vacated at H-hour by the leading division. Distance advanced: 0 km
3	0600 - 1800 D+1	The first echelon assaults the MBA, penetrating to a depth of approximately 10 km. Distance advanced: 10 km
4	1800 D+1 to 0600 D+2	The first echelon consolidates its gains, probes the defense, and prepares to continue the attack on D+2. During the last part of the period the second echelon division moves forward to attack positions in readiness for commitment on D+2. Distance advanced: 0 km
5	0600 - 1800 D+2	Both divisions attack in concert to complete the breakthrough. Distance advanced: 10 km

6	1800 D+2 to 0600 D+3	The fresh division continues the attack against a weakening defense fought from hastily prepared positions. The original first echelon division reduces bypassed defenders and prepares to be refurbished. Distance advanced: 8 km
7	0600 - 1800 D+3	The leading division, still exploiting the breakthrough, is involved in a meeting engagement with light but fresh defending forces. Distance advanced: 18 km
8	1800 D+3 to 0600 D+4	The leading division, having overcome the defender's forces in the meeting engagement, now launches a pursuit to the west. Distance advanced: 27 km
9	0600 - 1800 D+4	The leading division closes with the a hasty defensive position representing the last organized resistance east of the Rhine. The trailing tank division--now refurbished--moves forward in preparation for the final pursuit to the Rhine. Distance advanced: 5 km
10	1800 D+4 to 0600 D+5	The fresh division passes through the engaged division and pursues retreating NATO forces to the Rhine. The engaged division continues to reduce the defensive positions encountered in the previous period. Distance advanced: 95 km

destination. Events that involve fewer than 20 vehicles have been arbitrarily excluded for the Thracian case. (The effect of this exclusion is to delete about 7 percent of the moving vehicle population as candidates for engagement by the MMB.)

- o TARGET. A target is a 20-vehicle subset of an event. Any remainder less than 20 is treated as an additional target.
- o PERIOD. The scenario has been divided into 10 periods of 12 hours each. Periods 1, 3, 5, 7, and 9 are daylight periods; 2, 4, 6, 8, and 10 are night periods.

The following discussion is concerned mainly with four aspects of the data available in the model, viz.,

1. The hourly rate at which targets are generated; for use in sizing the combat power of the MMB.
2. The rate at which events are generated; for use in devising the tactical structure of the brigade.
3. The composition of events in terms of targets; also for use in structuring the brigade.
4. The duration of events; for use in assessing required rates of fire and for evaluating the need for system responsiveness.

GENERATION RATES FOR TARGETS AND EVENTS

During the 120-hour scenario, 858 events occur in the region between 15 and 220 km from the line of contact. These events generate a total of 2793 targets, as defined earlier. If this activity were distributed uniformly over time one might suppose that there would be 7(+)

events and 23 targets appearing each hour. In fact however, there is a great deal of hour-to-hour variability in the appearance of both events and targets, as shown in Fig. 1. If the MMB were sized to deal only with the average rates, it would be overtaxed in something like 40 percent of the scenario hours.

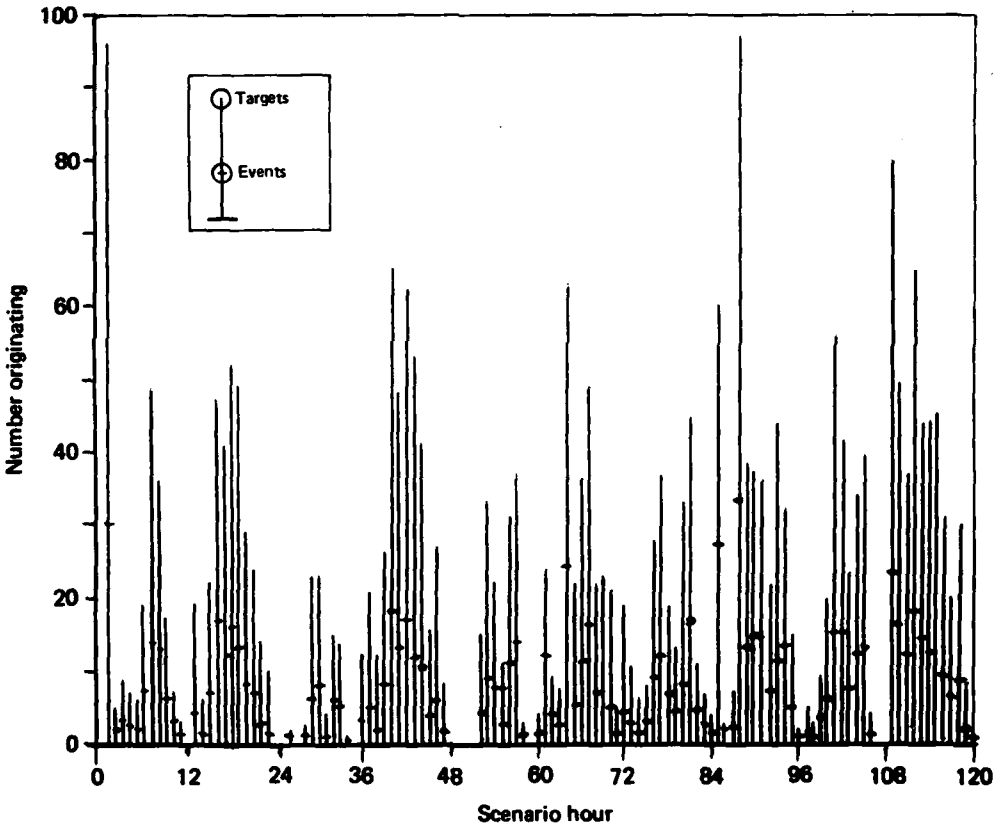

Fig. 1 — Hourly appearance of targets

Figure 2 gives a cumulative distribution curve of the hourly rate at which targets appear in the synthetic history. Here it can be seen that no targets appear in about 12 percent of the scenario hours; the

curve rises to a median hour of about 17 targets and reaches a maximum of 97 targets in the most intense hour of the scenario.

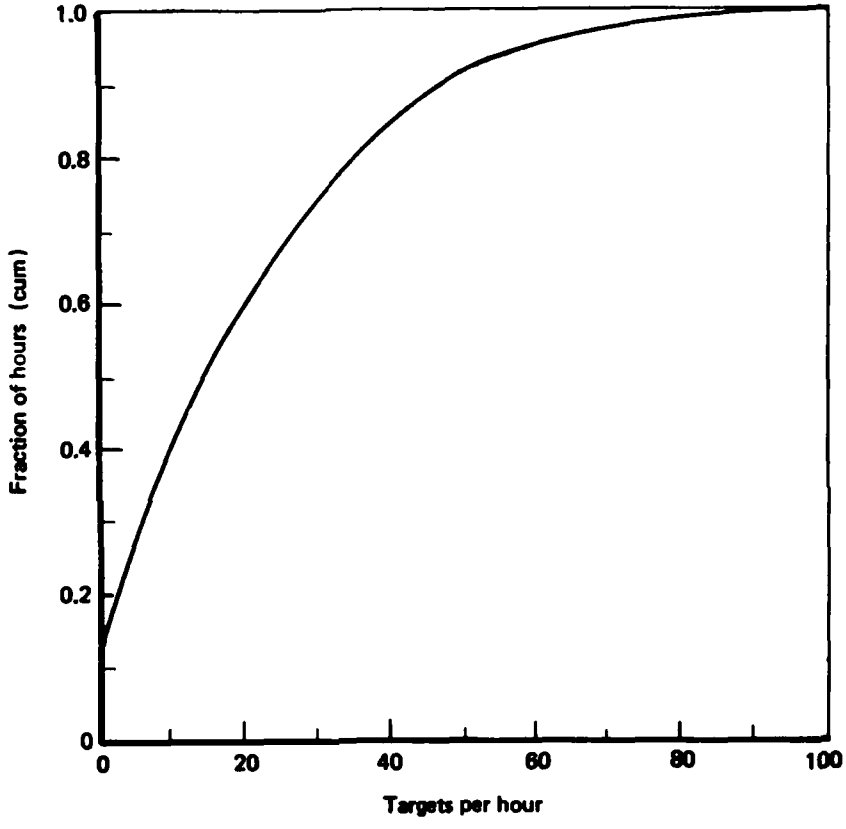

Fig. 2 — Distribution of hourly target rate

Figure 3 gives a similar distribution curve for the hourly occurrence of events. Here it can be seen that there are 5 events in the median hour and 33 events in the most intense hour.

The data from Figs. 2 and 3 will be used in a later section to estimate the fraction of the scenario activity that an MMB of a stipulated size and configuration might be expected to address.

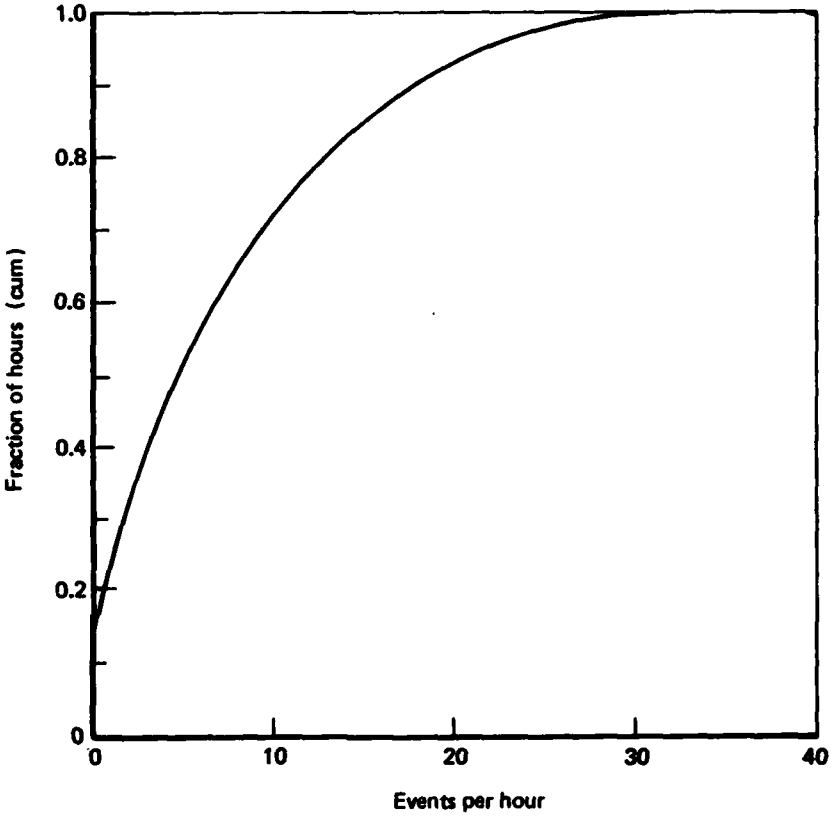

Fig. 3 — Distribution of hourly event rate

TARGETS PER EVENT

The number of new targets appearing as each event occurs varies from a low of 1 to a high of 8; the median event consists of 3 targets. The complete distribution is shown in Fig. 4.

The curve in Fig. 4 will be used subsequently as an aid in evaluating various alternative tactical structures for the brigade. It will have particular relevance for the amount of combat power that should be incorporated in the basic fire unit or "battery."

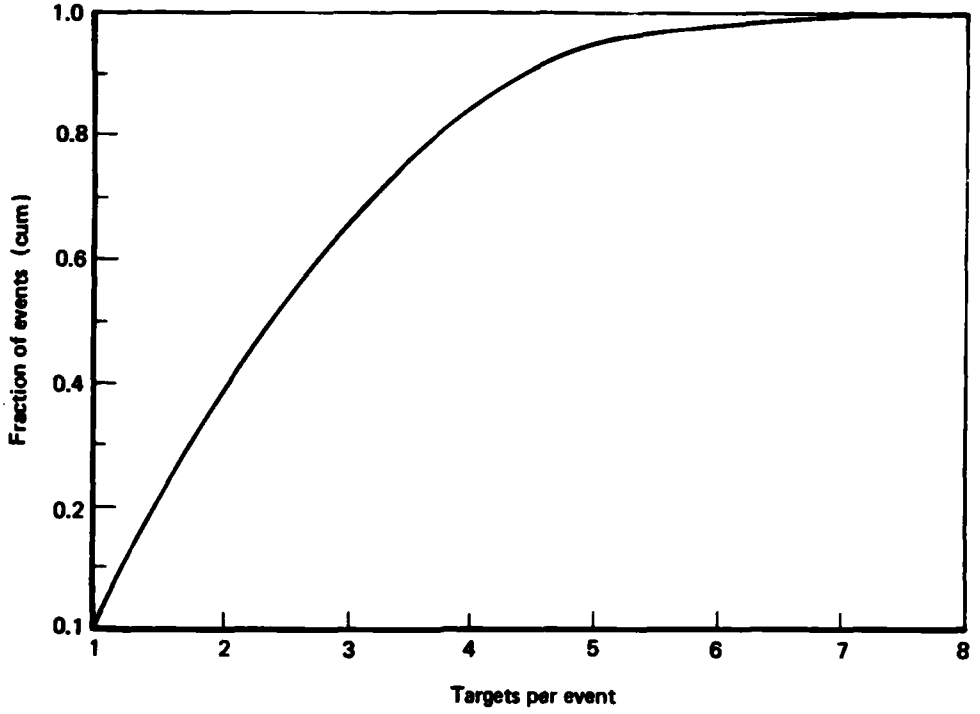

Fig. 4 — Distribution of events according to size

DURATION OF EVENTS

Once a target takes the road, it is presumed to move without interruption at a stipulated speed until it reaches its destination. The transit times for the events being considered here range from a low of 7 minutes to a high in excess of 11 hours. The transit time for the median event is 83 minutes, while the transit time for the median target is slightly higher--100 minutes. The distribution of all targets according to transit time is given in Fig. 5.

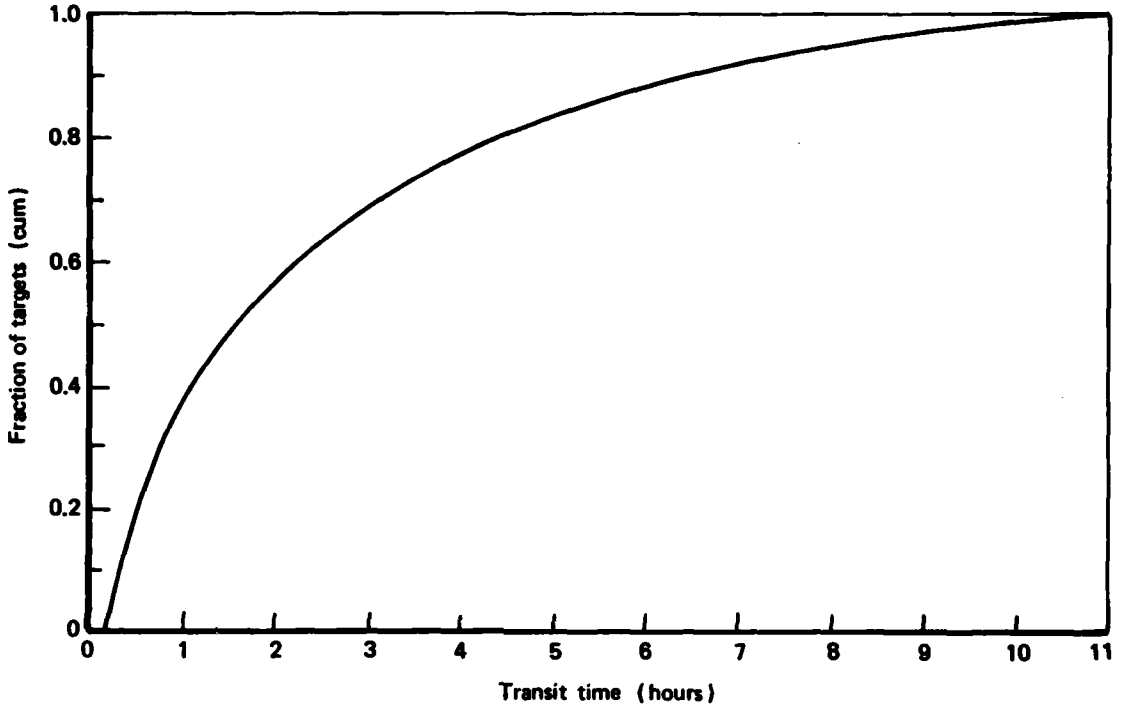

Fig. 5 — Distribution of targets according to transit time

The data in this figure should be useful in helping to understand how much responsiveness must be incorporated in the target acquisition and command-control-communications aspects of the MMB. They may also be useful in determining the rate of fire that should be sought. (But note here that the transit times contained in the history are predicated on unmolested movement rates. If the target system were subjected to attack, it is reasonable to suppose that transit times would increase and that the rate of fire required of the MMB might therefore be somewhat less than is suggested by the history.)

INTERPRETING THE ACTIVITY LEVELS

The activity levels in the synthetic history, as given earlier in Fig. 1, can lead to a variety of interpretations concerning the implied demands for MMB fires. Two of the factors that must be considered--the number of missiles to be fired at each target and the hourly variation in target rate--will be dealt with in Sec. IV. A third, less obvious, point of interpretation will be discussed here.

In devising the synthetic history of enemy activity, the author allowed the enemy force to proceed through the entire five days of the scenario as though the rear area were completely unmolested. But many of the events in the history represent repeated moves by the same groups of vehicles, as they strive to "keep station" within an advancing force of large geographical dimensions. Similarly, much of the resupply activity incorporated in the history consists of repeated trips by the same supply trucks.

The issue of interpretation arises when the possible consequences of attacks against the target model are introduced. Obviously, attacks that take place early in the scenario should be expected to affect the behavior of the force in later periods, and the "history" would have to be modified accordingly. The more severe the attacks, the more extensive the modifications. Both the timing of events and the numbers of vehicles involved would almost certainly change.

But this does not mean that the history is not a useful aid in estimating the demands for fire that might be placed on the MMB, at least within certain limits. In fact the model readily affords two different views of the expected level of target activity, which can be

taken as representing the upper and lower bounds on that level.

The first or upper bound is given by the history in its undiluted form, i.e., as seen in Fig. 1. This view can be interpreted as either a target set that is never subjected to attack, or a target system in which all losses are replaced in time for the operation to proceed as though the force had not been attacked.

The lower bound is given by treating each vehicle as though it were attacked and put out of action when it first appears in a movement event, and by further assuming that these losses are not replaced.

These two bounds are illustrated in Table 2, which shows the number of targets presumed to appear each period in the undiluted history and the number of "new" targets that appear each period, "new" targets being defined as those consisting of vehicles not appearing in a previous event.

Table 2

PERIOD-BY-PERIOD APPEARANCE OF EVENTS AND TARGETS

	Number Appearing		
Period	All Events	All Targets	New Targets*
1	83	250	132
2	90	313	299
3	31	96	0
4	96	378	126
5	50	156	8
6	98	300	74
7	67	221	5
8	141	395	105
9	74	233	17
10	128	451	10

*"New" targets consist of vehicles that have not taken part in a previous event.

The undiluted period-by-period record of targets given in Table 2 is also useful by itself for evaluating the expected variability in the daily level of demand for fire support, and therefore for gaining some appreciation of the magnitude of the missile supply problems likely to be encountered by the MMB.

For the most part, the organizational synthesis described in Sec. IV will focus on the upper bound as the criterion for sizing the combat power of the MMB. However, the logistical implications of the spread between upper and lower bounds will also be explored. Quite aside from these particular interpretations, it seems likely that there is as much to be learned from the period-to-period variability in activity levels as there is from the absolute levels shown in Table 2.

EXTRAPOLATING TO THE THRACIAN SCENARIO

To postulate a reasonable set of presumptions about the likely size of a Soviet invasion of Turkish Thrace, a range of possible sizes was explored, using the Rand Theater Air-Ground Study (TAGS) combat model. This investigation suggested that the smallest number of divisions the Soviets should commit to such an enterprise is 6, and that a prudent Soviet high command would probably commit as many as 10 or more.

The target system described above represents a little more than half of the rear area activity associated with an attack by a 5-division tank army. Therefore, the total size of the target set to be dealt with in the Thracian scenario is something like two or three times as large as the model presented in this section.

A second difference between the Central Europe target model and the activity that might be expected to develop in Thrace is that the hypothetical offensive campaign in the Central Europe case covered a distance of some 200 km in only 5 days, whereas the campaign in Thrace might cover twice that distance and take twice as long. The implication, at least for present purposes, is that the power projection force for Thrace would have somewhat more time to do its job than might be suggested by the Central Europe target model.

It will be well to keep these points in mind during the synthesizing process described in the next section of this Note, as well as when evaluating the number of MMBs that seem to be demanded by the Thracian case.

IV. SYNTHESIZING A MOBILE MISSILE BRIGADE

The discussion leading to this point has defined the general character of the MMB, assigned it a combat role, and described the target system it is expected to engage. In this section of the Note, these factors will be used as the raw material for an exercise in organizational synthesis.

Two terms will be used frequently in this section in a particular way--"engage" and "service." The distinction intended here is as follows:

- To engage a target or an event means to take it under fire with at least 1 missile.
- To service a target or an event means to deliver a stipulated number of missiles against it in the course of a fire mission.

PROCEDURE

The heart of the synthesizing effort consists in establishing a force firing rate to meet a stipulated target rate. The target rate will be evaluated in terms of the numbers of events and targets expected to appear each hour over the time span of the scenario. The force firing rate will be evaluated first in terms of the total number of launchers needed to service the target model. Thereafter, the influence of various engagement policies and alternative internal groupings of launchers on force firing rate will be examined.

The first step will be to explore a range of practical firing rates that individual launchers might reasonably be expected to achieve under

combat conditions. A major factor to be considered will be the effects of various displacement policies, i.e., the degradation in hourly firing rate that comes about as the launchers change position.

To translate firing rates into target servicing rates it is first necessary to establish the service level, i.e., the number of missiles to be launched at each target. The next step in the synthesis will address this issue.

Determining the total number of launchers desired in the brigade involves a comparison of various firing rate/service level combinations with the target model. One of the important questions raised in this part of the synthesis concerns the fraction of the target history--the demand for fires--against which the brigade is to be sized.

The final element of the synthesis considers the grouping of the brigade's complement of launchers into fire units for purposes of fire allocation and other aspects of tactical control. This in turn requires that the issue of allocation and engagement policy be dealt with.

FIRING RATE FOR A SINGLE LAUNCHER

In Sec. II it was suggested that the principal weapon of the brigade would be a missile launcher with a firing rate of 4 to 6 rounds per hour.* This is intended as a design rate that the launcher should achieve under test conditions, i.e., unhampered by environment or enemy

*Multiple-launcher configurations, e.g., Patriot and MLRS, have been excluded from the synthesis, primarily to simplify the exposition. At the same time, and despite the clear advantages of multiple launchers, the launching of 2000 pound missiles from a multiple launcher implies a system of such weight and bulk as may well be incompatible with the strategic mobility precepts set forth earlier.

activity. Design rates of 4 rounds per hour and 6 rounds per hour will be evaluated.

In combat, however, it is likely that the firing unit will come under counterbattery fire from time to time. If the MMB proves indeed to be a serious threat to the Soviet force, then the likelihood of counterbattery fire may be quite high. This being so, it will be prudent to assume a fairly stringent displacement--or "shoot-and-scoot"--policy as a standing operating procedure for the brigade's launcher units. The effect of such an SOP will be to lower the practical rate of fire to something significantly less than the design rate.

Two alternative displacement policies will be examined here, viz.,

- o Shoot-move-shoot (S-M-S)
- o Shoot-shoot-move (S-S-M)

If it is assumed that each "move" will delay the next missile launch by 15 minutes, then the two alternative design rates of fire and the two alternative displacement policies yield the four possible practical rates of fire shown in Table 3.

Table 3

PRACTICAL LAUNCH RATES, IN MISSILES PER LAUNCHER PER HOUR

	Practical Rate	
Design Rate	S-M-S	S-S-M
4 per hour	2.0	2.7
6 per hour	2.4	3.4

TARGET SERVICE LEVELS

The service level, or number of missiles to be fired, for each target will depend on the effects desired and on some rather rigorous munitions analysis, which has not been undertaken. The munitions most likely to satisfy the needs of the MMB for the 1980s appear to be target-seeking submunitions and scatterable mines.

Each target as defined herein will consist of a linear array of up to 20 vehicles, which will be spaced from 25 to 50 m apart, depending on driving conditions. About 20 percent of the total vehicle population will be armored and the other 80 percent will be thin-skinned. However, some targets will consist entirely of armored vehicles, some will be mixed, and some will contain only thin-skinned vehicles. Given targets of this character, the service level ultimately established would necessarily be somewhat arbitrary, even if a thorough weaponeering analysis were to be completed.

In lieu of weaponeering analysis, two values for the required service level will be considered here, viz., levels of 3 missiles and 4 missiles per target. Quite apart from the weapons effects issue, a brief survey of the logistics problem suggests that service levels of this order may be as high as can be reasonably entertained. The missile supply problem will be explored briefly at the end of this section. In the meanwhile, if weaponeering analysis reveals a deficiency in effectiveness at these levels, then the remedy should possibly be sought in better munitions rather than in a higher service level.

SIZING THE BRIGADE: HOW MANY LAUNCHERS?

So far as the method is concerned, it matters little whether the brigade is sized here to deal with the original target model or with the expanded target set appropriate to the Soviet force in Thrace. In the interest of simplicity, the brigade will be synthesized on the basis of the smaller target set.

The initial step in sizing will be to calculate the numbers of targets that can be serviced hourly by various numbers of launchers, assuming the practical firing rates and the alternative service levels already discussed. The results of these calculations are displayed graphically in Fig. 6.

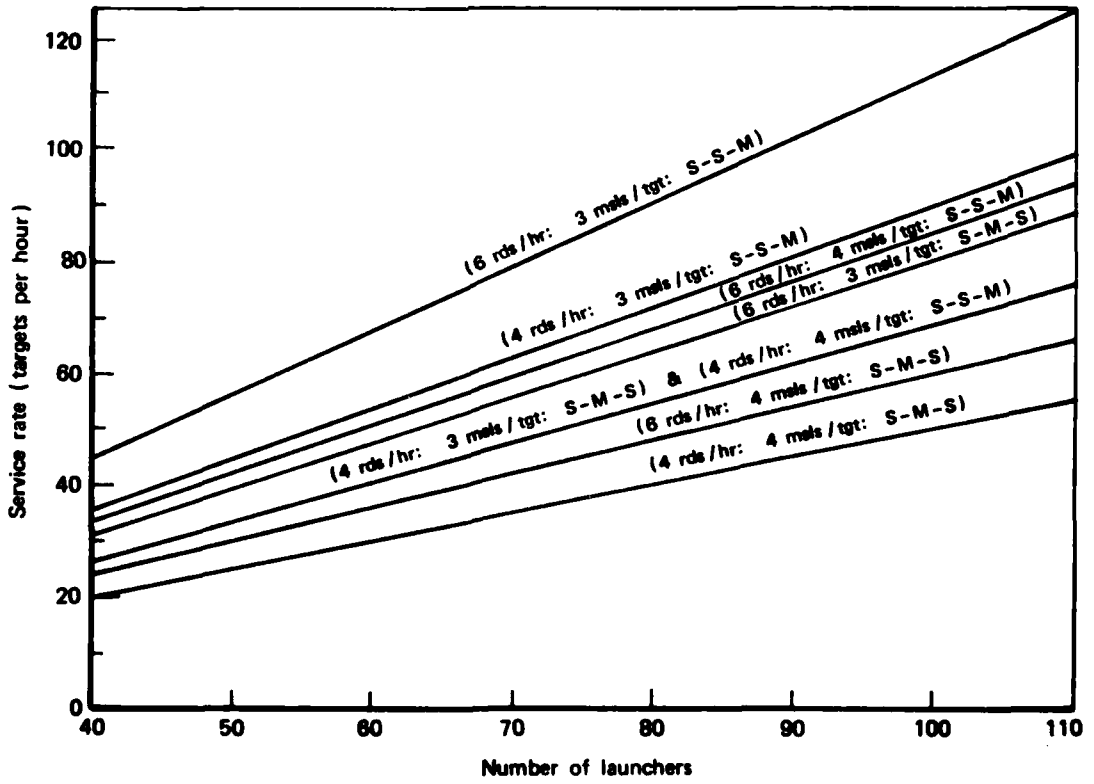

Fig. 6 — Target service rate as a function of number of launchers in the brigade

Using the most favorable combination available--a design launch rate of 6 missiles per hour, a displacement policy of S-S-M, and a service level of 3 missiles per target--Fig. 6 shows that the brigade will need 86 operational launchers to service the 97 targets that are generated during the most intense hour of the scenario. For the least favorable set of assumptions--i.e., a design launch rate of 4 per hour, a policy of S-M-S, and a service level of 4, the number of launchers required in this hour rises to 197.

If an important premium attaches to smallness of size, as was argued earlier, it seems reasonable to question whether or not it is prudent to size the brigade's capabilities against the most intense hour in the scenario. And if the answer is in the negative, then what is a reasonable design objective?

In Fig. 2, Sec. III, it may be observed that the number of targets appearing each hour is 48 or less, in 88 percent of the scenario hours. Figure 6 shows that a brigade designed to deal with this level of target activity would need only half as many launchers as would be needed for the most intense hour; this is true for any of the combinations of firing rate, service level, and displacement policy shown in the figure. Moreover, it can be shown that a brigade that is capable of servicing 48 targets per hour can actually deal with 92 percent of all of the targets that appear during the scenario. This appears to be a reasonable goal to use as a preliminary design point.

The next task in sizing the brigade is to select one of the eight combinations of factors represented by the 7 functions displayed in Fig. 6.

Attainment of a design rate of fire of 6 missiles per hour, for a single launcher, does not seem overly optimistic for the 1980s. Moreover, given this rate of fire, a displacement policy of S-S-M appears to be entirely feasible, since displacement will take place in no more than 10 to 12 minutes following the first presentation of a firing signature from any firing site.

Having adopted these favorable assumptions about two of the three factors, one is led to take a more conservative view where the remaining factor is concerned. Despite the logistics implications discussed elsewhere in this section, a service level of 4 missiles per target is more reassuring than a level of 3, and will therefore be used in the synthesis.

A final reference to Figs. 2 and 6 shows that with these assumptions, a brigade containing 56 operational launchers should be able to service 47 or 48 targets per hour. This is tantamount to servicing all of the targets each hour in 88 percent of the scenario hours, as well as 92 percent of all of the targets in the history. This number of launchers will be taken as the initial design point.

TACTICAL GROUPINGS OF LAUNCHERS

If the fire of a large number of launchers is to be allocated efficiently and efficaciously, as they attempt to address large numbers of events and targets closely spaced in time, they should be grouped at one or more intermediate levels of aggregation. This is standard practice in the way armies in general organize their conventional artillery: Individual pieces are grouped in batteries (usually 4 to 6 pieces per

battery); batteries are grouped in battalions (3 or 4 batteries to a battalion); and battalions are collected into brigades, regiments, or groups (3 to 5 battalions).

In conventional practice, the precise form of the substructure adopted for fire support forces depends mainly on such factors as the tactical organization of the supported force, limits on the span of control and a largely empirical view of the capabilities of the weapon system. In the present synthesis these factors will be subordinated in favor of a somewhat novel attempt to shape the organizational structure to important features of the target system. In particular, the synthesis will attempt to satisfy three desiderata, viz.,*

1. The ability to assign the engagement of each event to a fire unit, or "battery," of minimum size; this to maximize the number of batteries in the brigade and, therefore, the number of events that can be taken under fire simultaneously.
2 The ability to engage all of the targets in an event simultaneously.
3. The ability to assign the engagement of each target to a single launcher.

*While these relationships will seem to imply a particular engagement doctrine as a norm for the force, the intent is not to establish such a doctrine here, but simply to devise an enabling organization that reflects the likely character of the target system. In practice, it should be expected that the commander of the force would employ the engagement practices, principles, and policies that seemed best to fit the circumstances of whatever battle he might be fighting. It should also be expected that the organization developed here would allow the force commander wide latitude in these matters.

Sizing the Battery

If each event is to be serviced by the elements of a single battery, then it will be important to match the number of launchers in the battery to some expectation about the number of targets in an event. As seen earlier in Fig. 4, the number of targets in an event varies effectively from 2 to 8. Since the battery will be of a fixed size, this spread gives rise to two salient observations.

1. If the battery contains fewer than 8 launchers, some events will not be completely engaged in accordance with the foregoing desiderata. The question arises: To what extent should this incipient deficiency be tolerated?
2. Conversely, if the battery contains more than 2 launchers it will have an excess of capacity for dealing with some fraction of the events. The question raised here is: To what extent should the implied underutilization be tolerated? Or, alternatively: Should the battery be enabled to engage two or more events simultaneously?

In exploring these questions it becomes clear that there is a range of compromise solutions available, each of which represents the ability to deal with a different fraction of the target model. The range of possibilities and their implied capabilities are shown in Table 4.

From Table 4 it seems evident that the battery should contain at least 4 launchers. If the battery contains fewer than 4 launchers some of the targets in some events will not be engaged, so long as each event is assigned to a single battery. In fact, with only 3 launchers to a

Table 4

FRACTION OF THE SCENARIO ENGAGEABLE BY BATTERIES OF VARIOUS SIZE

Battery Size (Launchers)	Engageable Fraction	
	Events	Targets
2	.31	.14
3	.66	.51
4	.84	.74
5	.95	.91
6	.99	.97
7	.99	.98
8	1.00	1.00

battery, only two-thirds of the events would be engaged in their entirety, and almost one-half of the targets would escape engagement.

Batteries of 4, 5, or 6 launchers could all engage a very large fraction of the events (although a battery consisting of only 4 launchers would default on about a quarter of the targets). However, Table 4 also shows that if a battery were restricted to engaging one event at a time, then batteries of 4, 5, or 6 launchers would be underutilized a good bit of the time, at least insofar as the engagement of concurrent events is concerned. One may conclude therefore that the battery should be able to engage at least two events simultaneously. This implies, in turn, another level of organization within the battery--a "platoon."

Battery Size and Number of Batteries

Clearly, there are a large number of possible battery organizations that would be of comparable suitability for dealing with the target system postulated herein. Platoons might just as easily consist of 2, 3, or 4 launchers; and batteries might just as reasonably contain 2, 3, or 4 platoons. These numbers suggest possible combinations that would yield alternative battery strengths of 4, 6, 8, 9, 12, and 16 launchers.

If the battery strength were to lie in this range, then the number of batteries subsumed by the initial design point of 56 launchers for the brigade would vary all the way from 4 to 14; but of the 66 combinations in this 6x11 matrix of possibilities (6 values of battery size and 11 values for the number of batteries) only 7 are of interest. These 7 options are displayed in Table 5 together with the number of batteries subsumed for the brigade by each size option.

Certain of these options can be eliminated with little or no debate, on grounds of obvious organizational inadequacy. For example, option 1 is inferior because (1) it implies an inordinate amount of overhead and thus violates the dictum of austerity; and (2) it stretches

Table 5

OPTIONS FOR BATTERY SIZE

Option	Battery Size	Batteries Subsumed	Total Launchers
1	4	14	56
2	6	9	54
3	6	10	60
4	8	7	56
5	9	6	54
6	12	5	60
7	16	4	64

the brigade commander's span of control beyond prudent limits.

Option 3 shares the shortcomings of option 1, if only in lesser degree. Additionally, option 3 contains a slightly larger number of launchers than stipulated earlier, although this may not be entirely a bad thing.

Options 6 and 7 go in a direction opposite that of 1 and 3, i.e., they concentrate the combat power of the brigade in such large packages that they may overtax the ability of the battery command function. And, like option 3, options 6 and 7 contain more launchers than the original specification.

Option 4 provides the number of launchers established earlier as a design point, but it also presents the span of control problem seen in option 1.

This leaves options 2 and 5 as perhaps the most attractive of those considered here, even though they are both about 4 percent smaller than the preliminary design point. (Option 2 also contains the seeds of a span-of-control problem. But, as will be shown later, this issue can be resolved somewhat more satisfactorily in the case of option 2 than it could be in the case of options 1, 3, and 4).

Options 2 and 5 are highly similar in terms of expected capabilities. Both contain 54 launchers, which means that either of them can service all of the targets appearing in 88 percent of the scenario hours and each can service 91 percent of all of the targets in the scenario.

If both options are assumed to be made up of identical platoons of 3 launchers each, then each will contain 18 such platoons. But a potentially important difference is that the force in option 2 consists of 9

batteries of 2 platoons each, whereas option 5 provides 6 batteries of 3 platoons each. When this difference is compared with the target model and the engagement desiderata discussed earlier, it can be seen that force option 5 can engage (not service) all targets simultaneously in all of the events. The option 2 force can achieve simultaneous engagement in 97 percent of the events. The price paid for this slight advantage by option 5 is the greater likelihood of underutilization against this particular target model.

On the other hand, the option 2 force can engage a greater number of large events simultaneously than can option 5. And option 2 presumably offers a greater degree of flexibility in tactical employment than does option 5, since the former has 9 batteries compared to 6 for the latter. This is an advantage that cannot be quantified, but its price is the greater number of battery headquarters required for the control of the same number of missile launchers.

Neither option 2 nor option 5 is clearly superior to the other. Option 2 will be carried forward in the current synthesis on the grounds of better potential utilization and the promise of greater tactical flexibility.

ORGANIZATIONAL LEVELS BETWEEN BATTERY AND BRIGADE

In conventional approaches to force design, it is almost habitual to insert another level of tactical control between the battery and the brigade levels. The practice has stood the test of time and should not be abandoned here out of hand. At the same time, however, there are costs associated with this additional layer; and, in the case of the MMB

and the Thracian scenario the costs may outweigh the demonstrable benefits, by a considerable margin. In any event, this fourth level of command and control (the other 3 being platoon, battery, and brigade) should not be inserted in the MMB simply to satisfy a convention.

Excessive span of control is often given as the reason for adding an intermediate level of authority to an organization. In the MMB, a size of 9 batteries threatens to overtax the span of control of the brigade headquarters, even though the batteries are functionally and operationally homogeneous and even though the role and modus operandi of the brigade will promote a certain evenness of tempo in combat operations that should ameliorate the span-of-control problem.

Another reason to consider a subgrouping of the batteries within the brigade is to provide unity of command in two or more widely separated areas. Similarly, it may be desirable to partition the target set for some reason, in a way that would make the formation of subgroups of batteries an advantageous option. Either of these eventualities makes a stronger case for a fourth organizational level than does the simple span-of-control argument.

A third reason for adding a fourth organizational level would be to achieve some desired ratio or other relationship between functionally dissimilar assets. For example, the performance and physical characteristics of the target acquisition system on which the missile units rely might argue for a ratio of two target acquisition systems to each three missile batteries. In this event it might be desirable to group these five elements into a single tactical entity, replicating the entity two or three times within the brigade so as to provide the

requisite number of launchers.

In the case of the MMB, the question of a fourth level of tactical command and control--a "battalion," in conventional practice--may well turn on the character of the target acquisition system adopted for the force. Pending completion of the target acquisition portions of the analysis, it will be prudent to make tentative provision for a battalion echelon in the structure of the brigade. However, in the interest of economy the battalion in this instance will be a purely tactical headquarters, there being little apparent merit in duplicating logistical resources across two or more battalions when the logistical function can be centralized at brigade level.

Since there are to be 9 batteries in the brigade, the modularity precept advanced in Sec. II suggests that there should be 3 battalions of 3 batteries each.

LOGISTICAL IMPLICATIONS OF TARGET RATE

Historically, armies in the field have been forced to seek compromises between the quantity of munitions to be delivered against particular targets and the quantities actually available. The need to compromise has been institutionalized in U.S. Army logistical practice in the form of the "Required Supply Rate" and the "Available Supply Rate" elements in the standard form of logistical plans and orders.

There is little reason to think that the MMB, nor any other power projection element, will be able to escape this dilemma to any important degree. Nevertheless, in devising the brigade's logistical capabilities it is important to have at hand an appreciation of the likely demands

for fire over the life of the scenario, including some estimate of both the average and the peak daily demand.

Table 2 in Sec. III shows that the peak 24-hour demand in the undiluted target model occurs during Periods 9 and 10, and that 684 targets appear in this interval. If the service level were only 3 missiles per target, the brigade would expend almost 2000 missiles, i.e., 2000 tons, in this one day. And since the target model represents one-third to one-half of the Soviet forces in the Thracian scenario, the total requirement for this one day could be as great as 6000 tons. The implied logistics burden is enormous.

Considering only the "new" targets as given in Table 2, the peak demand is seen to be 1239 missiles needed to service the 431 targets that appear in Periods 1 and 2. The implied demand for the Thracian case is thus in the general range of 2500 to 3500 tons for this 24-hour interval.

It is questionable whether the brigade's logistical capacity should be evaluated against these hypothetical peak loads or against a more modest estimate based, for example, on the presumed expenditure of missiles against a median level of activity.

If the target history data given in Table 2 are arranged in consecutive period pairs and then ordered, it will be found that the number of targets that appear in the median pair, for the undiluted target model, is 534. For "new" targets alone, the activity level in the median period pair is only 122.

For a service level of 3 missiles per target, then, it may be supposed that the logistics elements of the brigade should be able to han-

dle a daily load of at least 400 missiles. The flow of missiles into the theater would have to average about 1000 missiles per day.

An upper limit to the estimate of daily demand might be derived by applying a service level of 4 missiles per target to the median period in the undiluted target model. This limit amounts to approximately 2100 missiles per day for a single brigade and 6300 per day for the entire Thracian target set.

V. SUMMATION

It should be evident from the foregoing discussion that plausible cases can be made for a wide variety of alternative configurations for the MMB. In the final analysis, selection of one organizational alternative from among several close competitors should depend on a number of factors, including field tests, which are quite beyond the scope of the present synthesis. At the same time, the organization developed here depends upon a particular rationale which, it is hoped, may be found useful in making reasoned judgments about the likely utility of high technology power projection forces; in estimating the support required to sustain such forces in a distant theater of operations; and in evaluating the feasibility of deploying such forces, and--if necessary--extracting them.

THE TACTICAL STRUCTURE

The tactical structure of the MMB proposed here as a hypothetical research vehicle is shown in Fig. 7. In the preceding discussion, a number of points have been either raised or implied concerning the tactical employment of the brigade's firepower. These points will now be brought together and made more explicit in a summary description of the functions and responsibilities imputed to each tactical echelon, beginning with the lowest.

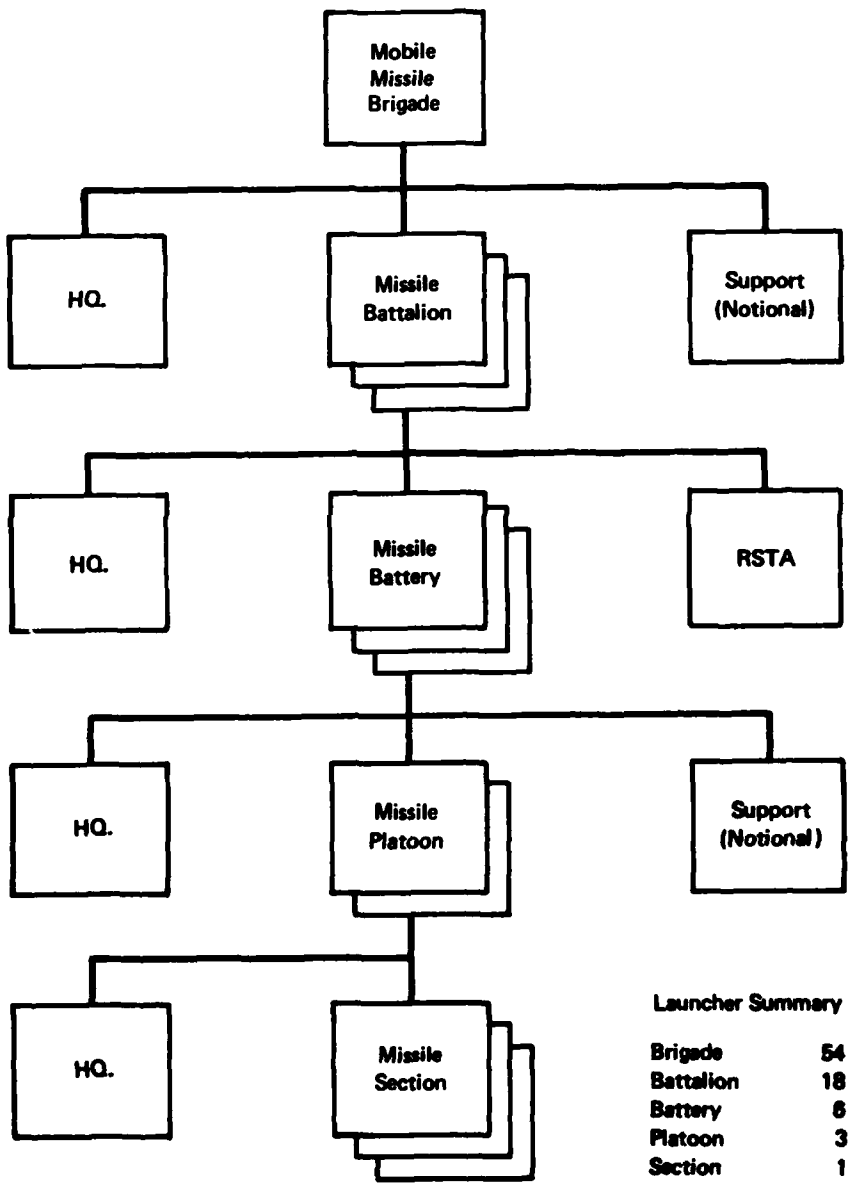

Fig. 7—Tactical structure of the MMB

Launch Section

The Section--consisting of a single launch vehicle and one or more missile transporters--is the smallest tactical element of the MMB.

For each missile launch, the Section receives range and azimuth information from its parent platoon; it converts this to appropriate missile and launcher settings; and fires on command of the platoon leader.

The Section is positioned by the platoon leader and displaces on his order.

Missile Platoon

The Platoon consists of three launch sections and a command group.

The Platoon engages all of the targets in an event, up to a maximum of 3, by the simultaneous fire of its launch sections. It receives range and azimuth data for each target it is to engage from its parent battery and assigns each such target to one of its sections. The first round of missiles in each fire mission is launched on order of the battery commander. Subsequent rounds are fired on order of the Platoon leader until servicing is complete.

The Platoon occupies a position area designated by its parent battery. It may displace on the order of the Platoon leader.

Missile Battery

The Battery consists of two platoons and a battery headquarters. It is the basic fire unit of the brigade.

The Battery receives fire missions from its parent battalion in the form of target location and description. The Battery converts target data to firing data, allocates the fire of one or both of its platoons to the mission according to the size of the event, and transmits firing data to the platoons.

The Battery can engage two events concurrently.

Missile Battalion

The Battalion consists of three missile batteries and a battalion headquarters. It is the lowest echelon that controls both target acquisition units and missile units.

The Battalion establishes *continuous* surveillance over a segment of hostile territory as specified by the brigade commander. As events appear in his area of responsibility, the battalion commander assigns each to one of the batteries under his control. Normally all of the targets representing a single event are assigned to a single battery as a single fire mission.

The battalion commander establishes priorities for the engagement of events that arise concurrently.

When operating in a part of the theater that is remote from the brigade headquarters, the battalion commander establishes liaison with the local commander of host country forces and coordinates the operations of his battalion with the general plans and intentions of those forces.

The Battalion may form the nucleus of a power projection force in situations that do not require a major share of the brigade's combat

power. In these circumstances the Battalion must be augmented with suitable control elements and support units. Its combat power may also be increased by the attachment of an additional missile battery.

Brigade

The composition of the Brigade includes a headquarters, three missile battalions, and suitable support elements. Three battalions should, however, be considered as a nominal combat strength. In practice the Brigade should be able to control as many as five missile battalions; similarly, it may deploy and enter combat with only two battalions when circumstances warrant.

The Brigade commander may also serve as the senior U.S. ground force commander in the theater.

The relationship between the Brigade and host country forces is one of general support in the broadest sense. The Brigade commander plans his operations so as to reinforce the strategy and the campaign plan of the local forces. At the same time, he seeks to avoid mutual interference between his operations and those of local forces.

The Brigade commander negotiates a suitable area of mission responsibility and obtains the unrestricted use of the necessary operating and support areas and facilities for the Brigade. He then apportions the mission and operating areas among the subordinate units of the Brigade.

The Brigade commader influences the course of the campaign by maintaining continuous surveillance over his region of responsibility, assigning and shifting the responsibilities of the battalions, and apportioning the available support among the battalions each day.

A MANPOWER ESTIMATE

The detailed study required to produce a fully rationalized manning table for the MMB will not be attempted here. However, it may be instructive to examine a first approximation of the number of personnel that might be needed to man the brigade under the terms of reference set out in Sec. II and in the preceding paragraphs of this section.

The estimate presented here--totaling nearly 2000 personnel--is almost twice as great as was hoped for at the outset of the synthesis. Nonetheless, it will, without any doubt, be regarded by some as an austere organization, especially when it is compared with the manning levels found in some current and recent U.S. Army missile organizations.

Beginning at the lowest *echelon*, the Launch Section has been assigned a personnel strength of 7. For comparison, the launcher section in the Little John firing battery has 11 men, and the Honest John launcher section includes 14. If high technology truly promises savings in manpower, a reduction of this order should not be an unreasonable expectation.

The Launch Platoon Headquarters is given a strength of 3 men; allowing for a platoon leader, a second-in-command and a radio operator-driver. This compares with a somewhat astonishing 28 in the case of Little John and a more modest figure of 8 in the Honest John platoon headquarters.

The Launcher Battery in the MMB is the locus of a large share of the missile supply activity alluded to earlier. As a result, the number of men assigned to the Battery Headquarters and Support Element here is 77, 58 of whom are directly involved in the missile resupply function.

Battalion Headquarters, as noted previously, performs tactical but not logistical functions. It also contains a reconnaissance, surveillance, and target acquisition (RSTA) system, which has not been defined as yet. A strength of 60 men has been allocated to this headquarters, with the recognition that the subsequent definition of the RSTA system might operate to increase this number somewhat.

The estimated strength of the Brigade Headquarters and Service component is taken almost entirely from existing Army organizations having functions and capabilities comparable to those visualized herein. The manning level is 629.

These figures yield a total strength for the brigade of 1934 personnel. For practical purposes, this number might be rounded up to, say, 2000. Of this number, 1059--virtually half of the brigade personnel--are involved in supplying missiles to the firing units.

From the standpoint of austerity, it is interesting to compare the combat power and manning of the MMB--in terms of the ratio of personnel to missile launchers--with some of the standard Army missile organizations. Such a comparison is given in Table 6.

The information in Table 6 is interesting on two counts. First, it suggests that the rough manning estimate given here for the MMB is not preposterously wide of the mark one might reasonably aim for in designing a power projection force of this sort.

Second, and perhaps more important, the ratio of combat power to personnel has, in the Army's own experience, varied widely where missile systems are concerned. The limited study reported here has not sought to discover the particular reasons underlying this phenomenon; but the

Table 6

RATIO OF PERSONNEL TO MISSILE LAUNCHERS IN SELECTED ORGANIZATIONS

Organization	Personnel	Launchers	Ratio
Honest John Battalion (Divisional)	263	4	66:1
Honest John Battalion (Corps)	408	6	68:1
Little John Battalion	213	4	53:1
Sergeant Battalion	377	4	94:1
Lance Battalion	442	6	74:1
Pershing Battalion	1677	36	47:1
MMB	1934	54	36:1

phenomenon itself encourages further pursuit of the notions explored in the present Note.

TOPICS FOR FURTHER RELATED RESEARCH

The topics that seem most in need of further research to relieve some of the conjecture encountered in this Note are these:

1. Weaponeering, to evaluate the service level issue more accurately.
2. Selection and integration of an RSTA system.
3. Analysis of fire direction needs and solutions.
4. Selection and integration of communications systems.
5. Selection of a family of vehicles.

6. Refinement of missile and launcher specifications.

7. Analysis of supply, maintenance, engineer, and other aspects of support for the brigade.

8. Evaluation of strategic mobility and intertheater deployment issues.